(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 131 997 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
12.09.2001 Bulletin 2001/37

(51) Int Cl.[7]: **A01J 7/00**

(21) Application number: **01202454.3**

(22) Date of filing: **20.03.1995**

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB IE IT LI NL SE

(30) Priority: **25.03.1994 NL 9400471**
29.03.1994 NL 9400495

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
95912499.1 / 0 700 245

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Remarks:
This application was filed on 26 - 06 - 2001 as a divisional application to the application mentioned under INID code 62.

(54) A construction including an implement for milking animals

(57) The invention relates to a construction including at least one implement for automatically milking animals, comprising a computer, at least one milking robot for applying teat cups to the teats, which implement includes at least one computer for identifying an animal that has arrived at the implement. The computer is provided with a programme, with the aid of which the implement is suitable for

- recording the amount of milk produced by an animal during milking,
- calculating on the basis of this data the expected milk yield of the animal, and
- activating the milking robot on condition that the expected milk yield of said animal will exceed a base value.

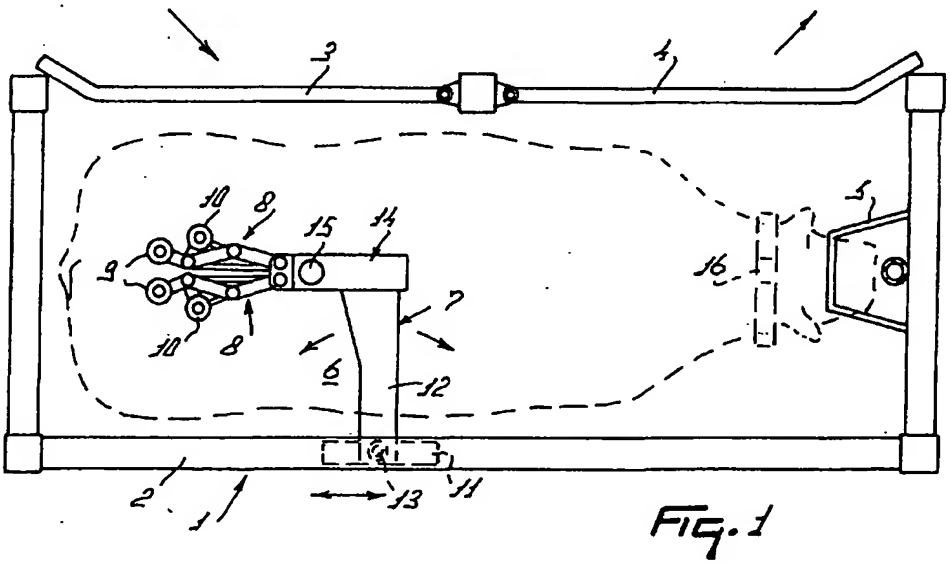

FIG. 1

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Description

[0001] The present invention relates to a construction including at least one implement for automatically milking animals, according to the preamble of claim 1. According to the invention such a construction comprises the characterizing features of claim 1. Embodiments are disclosed in claims 2 to 9.

[0002] In order to facilitate the connecting of the teat cups to the teats of an animal and in order to make the milking for the animal more comfortable, the construction according to the invention is characterized in that at least a number of teat cups are movably connected by means of movable arms to a robot arm, said teat cups being capable of freely moving in respect to the movable arms with the aid of pulling elements, such as cables or cords. Movable arms are to be understood to mean arms or other elements which are movable relative to each other as well as relative to the robot arm. The movable capability of the teat cups relative to the robot arm provides an efficient connecting of the teat cups to the teats, whilst the connection of the teat cups to the movable arms by means of pulling elements, such as cables or cords, provides additional freedom for the animal during milking. In accordance with the invention, the construction makes it possible for at least two teat cups to be connectable to the teats of an animal, both simultaneously and one after the other. The invention, therefore, also relates to a construction including at least one implement for automatically milking animals, such as cows, comprising a milking robot provided with teat cups, the construction being characterized in that at least two teat cups are connectable to the teats of an animal, both simultaneously and one after the other. Consequently, the teat cups can optionally be connected to the teats of more different types of animals, so that the number of animals to be milked increases.

[0003] In accordance with a further feature of the invention, a teat cup can be connected pivotably, rotatably or telescopically to a robot arm, whilst the teat cup is provided with a pulling element, such as a cable or cord, for withdrawing the teat cup. The invention, therefore, also relates to a construction including at least one implement for automatically milking animals, such as cows, comprising a milking robot provided with teat cups, the construction being characterized in that a teat cup is connected pivotably, rotatably or telescopically to a robot arm, whilst the teat cup is provided with a pulling element, such as a cord or cable, for withdrawing the teat cup.

[0004] So as to ensure the least obstruction during connecting of the teat cups, a teat cup is connected to a robot arm in such a manner that it is rotatable about its longitudinal axis. The invention, therefore, also relates to a construction comprising at least one implement for automatically milking animals, such as cows, comprising a milking robot having a robot arm provided with teat cups, the construction being characterized in that a teat cup is connected to the robot arm in such a manner that it is rotatable about its longitudinal axis. A very advantageous arrangement of the teat cups under the udder of the animal is obtained when the teat cups are pivotably connected to a robot arm in such a manner that in a first position, seen in plan view, the cups are located near the midway point of the udder and in a second position, also seen in plan view, remote from the midway point of the udder. The invention, therefore, also relates to a construction including at least one implement for automatically milking animals, such as cows, comprising a milking robot provided with teat cups, characterized in that the teat cups are pivotably coupled to a robot arm in such a manner that in a first position, seen in plan view, the cups are located near the midway point of the udder and in a second position, also seen in plan view, remote from the midway point of the udder. In particular, a teat cup is attached to this robot arm by means of three pivotal arms. The mode of connection of all four teat cups may be such that they are attached in pairs via two common pivotal arms to the robot arm. In this situation, the teat cups can be movable relative to the robot arm with the aid of stepping motors. These stepping motors may be located in the pivot points between the teat cups and the robot arm. Thus, eight stepping motors are moving four teat cups relative to the robot arm. In an advantageous embodiment, a teat cup may be connected to the robot arm via three pivotal arms in such a manner that it is rotatable about its longitudinal axis. The teat cup may then include a sleeve which is arranged freely rotatably about the exterior housing of the teat cup, the teat cup being connected to the robot arm by means of this sleeve.

[0005] A teat cup can be connected to a pivotal arm with the aid of a pulling element, such as a cable or cord. This pulling element may be passed through or along the pivotal arms, by means of which element the teat cup is connected to the robot arm, while the pulling element is further connected to an operating cylinder accommodated in the robot arm, preferably a pneumatic cylinder. In so far as the teat cup is rotatable about its own longitudinal axis, the pulling element acts on the sleeve around the exterior housing of the teat cup. The sleeve may have a bulging portion which, when the teat cup has been pulled against the relevant pivotal arm, fits in a recess made in the end of this arm.

[0006] In accordance with a still further feature of the invention, the implement includes a detector for determining the position of the teats of an animal to be milked, which detector is positioned during coupling of the teat cups to the teats substantially stationary and approximately in a central position under the animal to be milked. In this situation, the detector is located on either a separate robot arm, or on the robot arm to which the teat cups are connected via pivotal arms. In the latter case, the teat cups are provided such that, during connecting, they are movable with respect to the detector, and the teat cups can be positioned in such a manner

under the teats of the animal to be milked on the basis of the data supplied by the detector that they can be connected either simultaneously by one upward motion, or individually, e.g. when, after it has been connected, a teat cup is kicked from the udder by the animal. Whether the cups are connected simultaneously or individually, in both cases the teat cups may have been fitted in such a manner that they can be separately disconnected from the teats.

[0007] The invention not only relates to a construction including at least one implement for milking animals, but also to a method of automatically milking animals which are allowed to move about freely in a dwelling area, and which are individually allowed to approach a milking box provided with a milking robot, and which can be automatically identified by means of a computer prior to being possibly milked, in which method the computer is utilized for recording the point of time when the animal has been milked.

[0008] Such a method is known from e.g. European Patent application No. 00911892. By said method, an animal is not automatically milked within a predetermined time span. A drawback of this method is that a certain frequency or rhythm of milkings is imposed on the animals to a relatively extreme extent. It is an object of the present invention to provide a method of milking using a different criterion, preferably an animal-dependent one, for deciding whether or not an animal that has arrived at the milk box is to be milked. According to the invention, this is feasible when the computer also serves to record the amount of milk produced in each milking, to calculate the amount of milk produced between the point of time of reporting and that of a previous milking of the animal present as well as the expected milk yield of the animal and to activate the milking robot on condition that the expected milk yield of said animal present will exceed a base value.

[0009] By such a method, the frequency at which each of the animals will be milked is dependent of a characteristic of the animals. The animals are thus in a better position to pursue a frequency on their own, because the amount of milk being developed in an animal's udder as time lapses has a different value regarding each animal. By this scheme, one animal, e.g. a high-yield animal, can be milked once again earlier than another one having a lower yield.

[0010] Furthermore, the invention also relates to an implement for automatically milking of dairy animals, comprising a computer, at least one milk box arranged for milking an animal and at least one milking robot meant for applying teat cups, which implement may be provided with a selection area leading to the milk box and includes means for identifying, by means of the computer, an animal that has arrived in the implement, whereby the computer is provided with a programme, with the aid of which the implement is suitable for recording the amount of milk produced during each milking, for calculating the average daily production, as well as the respective milk yield to be expected, and for activating the milking robot on condition that the calculated milk yield to be expected exceeds a base value.

[0011] As it may be possible that the milking robot is not in use permanently, animals can enter the milk box without being milked there. In that case such an animal can be given some fodder (concentrate). The moment fodder is supplied to a specific animal can be recorded in the computer and may be relevant for the decision whether the animal will be milked or not when it enters the milk box the next time. Therefore, the invention further relates to a method of automatically milking animals which are allowed to move about freely in a dwelling area and to approach a milk box provided with a milking robot, whereby said animals are automatically identified by means of a computer in order to decide whether the animal will be milked in the milk box by the milking robot, characterized in that the computer is further utilized for

- recording the amount of milk produced by the animal during milking,
- calculating on the basis of this data the expected milk yield of the animal, and
- activating the milking robot on condition that the calculated milk yield expected to be produced by said animal will exceed a base value.

[0012] Further, the invention relates to an implement, wherein the method can be applied.

[0013] Besides the possibility to take the expected milk yield as criterion for milking an animal, another criterion may be the amount of fodder supplied in a certain time period. Therefore, the invention further relates to a method of automatically milking animals which are allowed to move about freely in a dwelling area and to approach a milk box provided with a milking robot, and which animals can be automatically identified by means of a computer prior to being possibly milked, in which method the computer is utilized for recording the moments on which an animal has visited the milk box and received fodder therein, characterized in that the computer is further utilized for

- calculating and recording the weight of the fodder eaten by the animal when it visits the milk box;
- activating the milking robot on condition that since the last milking the total amount of fodder eaten by the animal exceeds a base value.

[0014] Also, the invention relates to a construction wherein the latter method can be applied.

[0015] Another criterion for milking an animal may be the time passed since the animal was last fed in the milk box. Therefore, the invention further relates to a method of automatically milking animals which are permitted to find their way individually to one or more milk boxes, at which the animals are automatically identified with the aid of a computer connected to identification means,

characterized in that the computer is utilized for the recording of the points of time at which an animal is fed at the milk box and to activate, provided that a predetermined time has passed after the animal in question was last fed in the milk box, a device for bringing the fodder in reach of the animal, while a device for the automatic milking of animals comes into operation. Again, the invention also relates to a construction wherein the latter method can be applied. As it is preferable to milk high productive animals before other animals, the invention also relates to a construction including at least one implement for automatically milking animals, comprising a computer, at least one milk box arranged for the milking of an animal and at least one milking robot for applying teat cups to the teats of the animal and for milking the animal, which implement includes means, co-operating with the computer, for identifying an animal that has arrived at the implement, characterized in that the implement is constructed in such a way that it is suitable for

- recording the amount of milk produced in a predetermined time period, e.g. the last twenty-four hours,
- calculating on the basis of this data the expected milk yield,
- allowing with preference animals to the milk box having an expected milk yield which exceeds the average milk yield of the animals in some extent.

[0016] For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 is a plan view of a milk box incorporating a milking robot and showing the contours of a milch animal, a cow in the present case;
Figure 2 shows, to an enlarged scale, the end of the milking robot of Figure 1, wherein two pairs of teat cups are coupled to the end of a robot arm, each via a separate pivotal arm construction;
Figure 3 is a side view of the end of the robot arm in the direction of the arrow III in Figure 2;
Figure 4 illustrates a teat cup and the manner in which it is connected to the end of a pivotal arm of the milking robot;
Figure 5 is a cross-sectional view taken on the line V-V in Figure 2, and
Figure 6 shows four positions the teat cups can assume with respect to the end of the robot arm.

[0017] Figure 1 is a plan view of a milk box 1, which includes a railing 2 and at one side is provided with an entrance door 3 and an exit door 4. A feed trough 5 is fastened to the railing 2 at the leading side of the milk box 1. At the side facing the entrance door and the exit door there is a milking robot 6. The milking robot 6 includes a robot arm 7, to whose end teat cups 9 and 10 are connected with the aid of two pivotal arm constructions 8. This robot arm 7 is assembled from a first portion 11 which is arranged such at the side of the milk box that it is movable in the longitudinal direction of the milk box 1, a second portion 12 which is rotatable with respect to the first portion 11 about an upwardly directed shaft 13, and a third portion 14 which is rigidly connected to the second portion 12 at a substantially square angle. The robot arm 7 can be moved upwards as an integral whole by means of a (non-shown) cylinder. Also moving the robot arm 7 in the longitudinal direction of the milk box 1 and rotating the second robot arm portion 12 about the shaft 13 is effected with the aid of (non-shown) cylinders. These cylinders may be either hydraulic, pneumatic or electromechanical ones. A detector 15, e.g. a laser detector, is accommodated on the third robot arm portion 14, with the aid of which detector the position of the teats of an animal to be milked is determined. The pivotal arm constructions 8, at the end of each of which a teat cup 9 and 10 is fitted, are pivotally connected to the end of the third robot arm portion 14. In addition, a collar including a transponder 16, which is part of a (non-shown) cow identification system, is provided around the neck of the cow, which transponder co-operates with a sensor which may be placed near the feed trough 5 and is in connection with the computer of the system.

[0018] Figures 2 and 3 are a detailed representation of the end of the robot arm 7 with the pivotal constructions 8. The second portion 12 of the robot arm 7 consists of a first box-like beam and a second box-like beam disposed thereunder. The milk tubes 19 and the pulsation tubes 20 of the teat cups 9 and 10 are stored in the second box-like beam. Rigidly connected to the second robot arm portion 12 there is the third robot arm portion 14. Also this third robot arm portion 14 includes a first box-like beam 21 and, arranged thereunder, a second box-like beam 22, these box-like beams 21 and 22 being in connection with the box-like beams of the second robot arm portion 12. Also here, the milk tubes 19 and the pulsation tubes 20 extend through the lower box-like beam 22. The laser detector 15 is disposed pivotably or rotatably on the third robot arm portion 14. A holder 23 is secured to the end of the third robot arm portion 14, in which holder the two pivotal arm constructions 8 are accommodated such that they are rotatable about predominantly vertically extending pivot shafts. The pivotal arm constructions 8 can be rotated with respect to the holder 23 with the aid of electric motors 24, which are in the form of stepping motors. Each of the two pivotal arm constructions 8 includes four pivotal arms 25, 26, 27 and 28. The pivotal arms 25 are rotatable in a predominantly horizontal plane with respect to the third robot arm portion 14 with the aid of the stepping motors 24. The pivotal arms 26 are rotatable in a predominantly horizontal plane with respect to the arms 25 with the aid of electric motors, more specifically stepping motors 29. The arms 27 and 28 are both capable of rotating in a predominantly horizontal plane relative to the arms 26

with the aid of electric motors, more specifically stepping motors 30 and 31, whose shafts are in alignment. The stepping motors 24, 29, 30 and 31 are disposed in the pivot points of the pivotal arm constructions 8, with the aid of which the teat cups 9 and 10 have been coupled to the robot arm 7.

[0019] With the aid of the two pivotal constructions 8, each assembled from four pivotal arms 25, 26, 27 and 28 and four stepping motors 24, 29, 30 and 31, the teat cups 9 and 10 can be moved in many configurations under the udder with respect to a robot arm 7 with detector 15 which is placed in a stationary position under the animal. The detector 15 is thereby located in a fixed position relative to the milk box 1, which promotes searching for and finding the teats. Figure 6 shows four of such configurations. By moving the milking robot 6 in the longitudinal direction of the milk box 1 and by pivoting the robot arm 7 about the upright shaft 13, the robot arm 7 and consequently the detector 15 can always be placed in such a manner under the animal that by operating the stepping motors 24, 29, 30 and 31 the teat cups 9 and 10 can be moved to under the teats of the animal to be milked, so that they can be connected by an upward motion of the robot arm 7 and by a vacuum produced in the teat cups. After the teat cups have been connected, the robot arm 7 can be moved downwardly and slightly forwardly. The teat cups 9 and 10 connected to the teats remain in this situation in connection with the robot arm 7 by means of a flexible pulling element 32, e.g. a cable or cord. One end of this pulling element 32 is connected to a teat cup 9, 10 and the other end to a cylinder accommodated in the third robot arm portion 14, which cylinder may be a pneumatic, hydraulic or electromechanical one. The cylinders provided for all four teat cups are denoted in Figures 2 and 5 by reference numeral 33. When the teat cups 9 and 10 are in the state in which they are not connected to the teats of an animal, they are pulled by the cylinders 33 and the pulling element 32 up against the end of the respective pivotal arms 27 and 28. As soon as the teat cups have been connected to the teats, the cylinders 33 are released, so that the robot arm 7 can be moved; the teat cups continue to be freely movable with respect to the robot arm 7. When a given udder quarter has been stripped, which may be detected with the aid of a flow sensor in the relevant milk line, then the vacuum in the relevant teat cup is removed and simultaneously the relevant cylinder 33 is energized, so that, when the teat cup drops from the teat, it is immediately pulled up against the end of the relevant pivotal arm 27 or 28. Since the various pivotal arms are movable relative to each other and in conjunction movable relative to the third robot arm portion 14, in which the cylinders 33 are accommodated, it is not well feasible to connect the pulling element 32 directly from the point of connection at the teat cup to the relevant cylinder. The pulling element 32 must be threaded along a plurality of pulleys near the pivot points between the pivotal arms relative to each other and of the pivotal arms 25 and the third robot arm portion 14. For each pivotal arm construction 8 there is a set of pulleys for each of the two pulling elements 32, by means of which a teat cup 9 and a teat cup 10 are connected to two cylinders 33 located one above the other inside the third robot arm portion 14. For both pulling elements 32 these sets of pulleys are located one above the other. A set of pulleys includes one pulley 34 arranged near the pivot point between a pivotal arm construction 8 and the third robot arm portion 14, a pair of pulleys 35 near the pivot point between the pivotal arms 25 and 26 and a pair of pulleys 36 near the pivot point between the pivotal arm 26 on the one hand and the respective pivotal arms 27 and 28 on the other hand. By successively passing a pulling element 32 from its point of connection at a teat cup between two pulleys 36 and two pulleys 35 and thereafter around a pulley 34 to the point of connection at the relevant cylinder 33, the pulling element 32 is accommodated in such a manner in the pivotal arm construction 8 that the freedom of motion of the teat cups relative to the robot arm 7 continues to be ensured to the best possible extent, when these cups are moved in predetermined configurations to under the teats of an animal. In particular, various configurations, such as those shown in Figure 6, can be obtained without any difficulties. The points of connection of the pulling elements 32 at the operating cylinders 33 are located at that side of the third robot arm portion 14 that is remote from the pivotal arm constructions 8. Each of the pulling elements extends from a teat cup between pairs of pulleys 36 and 35 and along a pulley 34 through the entire third robot arm portion 14 to the rear side thereof and from there via a pulley 37 to a pulley 38 disposed at the rear side of the cylinder and from there to the rear wall of the third robot arm portion 14. By passing the pulling element 32 along the pulleys 37 and 38 there is effected an extra large stroke of the pulling element relative to the much more limited stroke of the operating cylinder 33.

[0020] With the ample freedom of motion of the teat cups 9 and 10 with respect to the robot arm 7, it is advantageous when the milk and/or pulsation tubes 19 and 20, respectively, connected to the teat cup allow this freedom of motion of the teat cups to the best possible extent. To achieve this, the teat cups are connected to the pivotal arm constructions 8 capably of rotating freely about their own longitudinal axis. As is shown in Figure 4, this is effected by disposing a sleeve 40 around the exterior housing 39 of the teat cups. The pulling element 32 then acts on the sleeve 40. Because of the capability of the teat cup to rotate freely in the sleeve 40, the milk and/or pulsation tubes allow the pivotal arms to move unimpededly in a pivotal arm construction. So as to render it possible for the sleeve 40 to be pulled in the appropriate manner against the end of the relevant pivotal arm of the pivotal arm construction, the sleeve 40 is provided with a bulging portion 41, which co-operates with a seat 42 in the end of a pivotal arm 27 and 28, respectively.

[0021] When, after the teat cups have been connected to the teats of the animal to be milked, one of the teat cups drops from its teat, e.g. due to kicking of the animal, then this teat cup is immediately pulled up against the end of the relevant pivotal arm and it is connected again by determining once again with the aid of the detector the position of the teat from which its cup has dropped. In this situation, the stepping motors of the relevant pivotal arm construction can be controlled such that the loose teat cup is moved to under said teat, whereafter the robot arm is moved upwards and a vacuum is produced in the teat cup until the cup grips the teat. Therefore, the present construction of individually controllable teat cups renders it possible for the teat cups to be connected both simultaneously and each one individually.

[0022] The method according to the invention may be adopted in a milking implement for automatically milking animals, as described before. The entrance door 3 and the exit door 4 may be in connection with a dwelling area for animals, such as a cowshed or pasture field. Through a suitable measuring element, the computer is capable of determining the amount of milk produced during each milking of each animal and of recording it, together with the respective point of time of milking, into an electronic memory. The milking implement also includes an identification element or sensor, which communicates with the computer, enabling an animal to be identified. In the present embodiment, this sensor is provided in the milk box near the feed trough 5. However, the sensor may equally well be provided outside the milk box for the implementation of a pre-selection on the admission of the animals to the milk box. The present embodiment makes use of the known per se identification system, wherein the sensor operates in conjunction with the transponder 16 carried permanently by each of the animals.

[0023] In the present embodiment, the entrance door 3 and the exit door 4 of the milk box are automatically controllable through the computer. In the initial position, the entrance door 3 is open and it is closed when the presence of an animal has been established automatically. When the animal is identified by the computer, the computer records the actual time as the point of time at which the animal reports herself in the milking implement. On the basis of the relevant animal's recorded history data on the times of previous milkings, the amount of milk given in each case, and on the basis of the point of time, as determined by the computer, at which an animal present has been identified, it is then determined by the computer what is the expected amount of milk to be given by that animal. For this purpose, the computer derives from the recorded data what is the average obvious development of milk or milk yield per unit of time of the relevant animal, expressed in litres/hr in the present invention, and how much is the length of time between the instant of identification and the latest milking of the animal present. Then, the product of the average milk development in the animal per unit of time and said length of time is the milk yield to be expected. If the milk yield to be expected is higher than a base value to be set, e.g. amounting to six litres, the computer activates the milking robot to milk the animal. When the milking of the animal has been completed or when the amount of milk to be expected does not exceed the base value, the exit door 4 is opened through the computer, so that the animal, whether or not being automatically driven off, leaves the milk box. The amount of milk produced by an animal will be the base on which the computer will decide if the animal will be milked again, when it comes to the milk box.

[0024] According to the present invention, the value of the average milk development per unit of time of each individual animal is determined automatically by means of a progressive average derived from the recorded data per animal. Upon identification of the animal in the milk box, each time a calculation is made for this purpose on the basis of a number, ten in the present embodiment, of such record entries concerning previous milkings of the animal. In doing so, the milk yield of the set number of milkings is summed and the sum is divided by the difference in time between the instant of the last milking recorded and that of the milking preceding the final milking of the set number of milkings to be included in the calculation. According to the invention, the possibility that an animal does not produce milk in the relatively short periods that she is in the milking implement to be milked each time, can be disregarded.

[0025] According to an alternative embodiment of the invention, the described identification of the animal and the determination of the milk yield to be expected can already take place in a buffer area or selection area belonging to the milking implement, in which area the entrance to the milk box is incorporated. For this purpose, such a buffer area comprises a sensor communicating with the computer for identifying an animal present therein, an exit to be released through the computer and giving access to the area for moving about freely in a cowhouse or pasture field, and a similar exit giving access to the milk box. In the present embodiment, the animal present in the buffer area is led into the said dwelling area if the milk yield to be expected does not exceed the base value, whereas it is led into the milk box if the milk yield to be expected exceeds the base value. In the latter case, identification in the milk box 1 is not required any more and it is possible to proceed to the milking of the animal immediately. However, according to the invention, a simpler but less elegant pre-selection can also be effected by simply providing an identification sensor near the entrance door 3 of the milk box 1. The entrance door 3 is then not opened until there is reported an animal which is allowed to be milked on account of the described criterion. Animals which are not to be milked under the criterion of the invention will disappear of their own account or will be pushed away from the entrance door 3 by other animals.

[0026] According to the invention, the embodiments

set forth hereinbefore have the advantage that the decision whether or not a reporting animal will be milked is made by means of a condition which, in a simple manner, plays along with the production feature of each of the animals. For, by the present method, high-yield dairy animals will be milked earlier and more frequently than relatively low-yield animals, which has a favourable effect on the health of the animals and the efficiency of the milking implement in use. Because the milk development in animals, at least in cows, after a first phase in which it varies linearly with time, appears to show a phase with diminishing returns, it should further not be deemed to be beyond the bounds of possibility that, owing to the milkings being performed as early as feasible, the method according to the invention leads to an increase in the milk yield per day, especially for high-yield animals.

[0027] Furthermore, the method set forth may also be adopted e.g. in a milking implement having a plurality of milk boxes or a plurality of milking robots, while the number of selection areas, too, may not be limitative to the application of the invention. Accordingly, the invention is not limited to what is set forth hereinbefore, but it also relates to all kinds of alternatives to the method falling, of course, under the terms of the following claims.

Claims

1. A construction including at least one implement for automatically milking animals, comprising a computer, at least one milk box arranged for milking an animal and at least one milking robot for applying teat cups to the teats, which implement includes at least one computer for identifying an animal that has arrived at the implement, **characterized in that** the computer is provided with a programme, with the aid of which the implement is suitable for

   - recording the amount of milk produced by an animal during milking,
   - calculating on the basis of this data the expected milk yield of the animal, and
   - activating the milking robot on condition that the expected milk yield of said animal will exceed a base value.

2. A construction according to claim 1, **characterized in that** at the milk box there is provided an animal-identification sensor, which supplies an animal-identification signal to the computer, on the basis of which signal the computer may automatically release the entrance of the milk box.

3. A construction according to claim 1 or 2, **characterized in that** when an animal is identified by the computer, the computer records the actual time as the point of time at which the animal reports herself in the milking implement.

4. A construction according to claim 3, **characterized in that** on the basis of the relevant animal's recorded history data on the times of previous milkings, the amount of milk given in each case, and on the basis of the point of time, as determined by the computer, at which the animal present has been identified, it is then determined by the computer what is the expected amount of milk to be given by that animal.

5. A construction according to claim 4, **characterized in that** the computer derives from the recorded data what is the average obvious development of milk or milk yield per unit of time of the relevant animal, expressed in litres/hr, and how much is the length of time between the instant of identification and the latest milking of the animal.

6. A construction according to claim 5, **characterized in that** the product of the average milk development in the animal per unit of time and said length of time is the milk yield to be expected.

7. A construction according to claim 4, 5 or 6, **characterized in that** the value of the average milk development per unit of time of each individual animal is determined automatically by means of a progressive average derived from the recorded data per animal.

8. A construction according to claim 7, **characterized in that** upon identification of the animal in the milk box, each time a calculation is made for this purpose on the basis of a number, e.g. ten, of such record entries concerning previous milkings of the animal.

9. A construction according to claim 8, **characterized in that** the milk yield of the set number is summed and the sum is divided by the difference in time between the instant of the last milking recorded and that of the milking preceding the final milking of the set number of milkings to be included in the calculation.

10. A construction including at least one implement for automatically milking animals, comprising a computer, at least one milk box arranged for the milking of an animal and at least one milking robot for applying teat cups to the teats of the animal and for milking the animal, which implement includes means, cooperating with the computer, for identifying an animal that has arrived at the implement, **characterized in that** the implement is constructed in such a way that it is suitable for

- recording the amount of milk produced in a predetermined time period, e.g. the last twenty-four hours,
- calculating on the basis of this data the expected milk yield,
- allowing with preference animals to the milk box having an expected milk yield which exceeds the average milk yield of the animals in some extent.

11. A construction including at least one implement for automatically milking animals, such as cows, comprising a milking robot (6) having a robot arm (7) provided with teat cups (9, 10), **characterized in that** a teat cup (9, 10) is connected to the robot arm (7) capably of rotation about its longitudinal axis.

12. A construction as claimed in claim 11, **characterized in that** the teat cups (9, 10) are connected to the robot arm (7) capably of pivoting in such a manner that in a first position, seen in plan view, they are located near the midway point of the udder and in a second position, also seen in plan view, remote from the midway point of the udder.

13. A construction as claimed in claim 12, **characterized in that** a teat cup (9, 10) is connected to the robot arm (7) by means of three pivotal arms (25, 26, 27; 25, 26, 28).

14. A construction as claimed in any one of the preceding claims 11-13, **characterized in that** the teat cups (9, 10) are attached to the robot arm (7) in pairs by means of two jointly pivotal arms (25, 26).

15. A construction as claimed in any one of the preceding claims 11-14, **characterized in that** the teat cups (9, 10) are movable relative to the robot arm (7) with the aid of stepping motors (24, 29, 30, 31).

16. A construction as claimed in any one of the preceding claims 11-15, **characterized in that** stepping motors (24, 29, 30, 31) are connected in the pivot points between the teat cups (9, 10) and the robot arm (7).

17. A construction as claimed in any one of the preceding claims 11-16, **characterized in that** four teat cups (9, 10) are movable relative to the robot arm by means of eight stepping motors (24, 29, 30, 31).

18. A construction as claimed in any one of the preceding claims 11-17, **characterized in that** a teat cup (9, 10) is rotatably connected to the robot arm (7) via three pivotal arms (25, 26, 27; 25, 26, 28).

19. A construction as claimed in claim 18, **characterized in that** a teat cup (9, 10) includes a sleeve (40) which is freely rotatable about the exterior housing (39) of the teat cup (9, 10).

20. A construction as claimed in any one of the preceding claims 11-19, **characterized in that** a teat cup (9, 10) is connected to a pivotal arm (27, 28) with the aid of a pulling element (32), such as a cable or cord.

21. A construction as claimed in any one of the preceding claims 11-20, **characterized in that** the pulling element (32) is connected to an operating cylinder (33), preferably a pneumatic cylinder, accommodated in a robot arm (7).

22. A construction as claimed in any one of the preceding claims 11-21, **characterized in that** the pulling element (32) acts on the sleeve (40) around the exterior housing (39) of the teat cup (9, 10).

23. A construction as claimed in claim 22, **characterized in that** the sleeve (40) is provided with a bulging portion (41) which, when the teat cup (9, 10) has been pulled up against the relevant pivotal arm (27, 28), fits in a recess (42) provided in the end of this arm (27, 28).

24. A construction as claimed in any one of the preceding claims 11-23, **characterized in that** the implement includes a detector (15) for determining the position of the teats of an animal to be milked, this detector (15) being during the connecting of the teat cups (9, 10) to the teats in about a central position under the animal to be milked.

25. A construction as claimed in claim 24, **characterized in that** the detector (15) is accommodated on the robot arm (7).

26. A construction as claimed in claim 24 or 25, **characterized in that,** during connecting, the teat cups (9, 10) are disposed capably of moving relative to the detector (15), and that they can be positioned such under the teats of the animal to be milked on the basis of the data supplied by the detector (15) that they can be connected simultaneously by an upward motion.

27. A construction as claimed in claims 24 to 26, **characterized in that,** during connecting, a teat cup (9, 10) is fitted capably of motion relative to the detector (15), and can be positioned such under a relevant teat of the animal to be milked on the basis of the data supplied by the detector (15) that the teat cup (9, 10) can be connected separately or reconnected again to the relevant teat by an upward motion, e. g. when the teat cup (9, 10), after having been connected, has been kicked from the teat by the animal.

28. A construction as claimed in any one of the preceding claims, **characterized in that** the teat cups (9, 10) are fitted such that they can be separately disconnected from the teats.

29. A construction including at least one implement for automatically milking animals, comprising a computer, at least one milk box arranged for milking an animal and at least one milking robot for applying teat cups to the teats, which implement includes at least one computer for identifying an animal that has arrived at the implement, **characterized in that** the computer is able to calculate the point of time from which an animal is allowed to enter the milk box and that the robot will be activated by a signal supplied by the computer, which signal is derived from an amount of touchable matter, such as the milk yield of said animal or the fodder eaten by said animal, whereby volume means or weighing means may supply this data to the computer.

30. A method of automatically milking animals which are allowed to move about freely in a dwelling area and to approach a milk box provided with a milking robot, and which animals can be automatically identified by means of a computer prior to being possibly milked, in which method the computer is utilized for recording the moments on which an animal has visited the milk box and received fodder therein, **characterized in that** the computer is further utilized for

- calculating and recording the weight of the fodder eaten by the animal when it visits the milk box;
- activating the milking robot on condition that since the last milking the total amount of fodder eaten by the animal exceeds a base value.

31. A construction including at least one implement for automatically milking animals, comprising a computer, at least one milk box arranged for the milking of an animal and at least one milking robot for applying teat cups to the teats of the animal and for milking the animal, which implement includes means, cooperating with the computer, for identifying an animal that has arrived at the implement, **characterized in that** the computer is provided with a programme, with the aid of which said implement is suitable for

- recording the points of time an animal to be milked has visited the milk box and received fodder therein,
- calculating and recording the weight of the fodder eaten by the animal when it visits the milk box, and
- activating the milking robot on the condition that since the last milking the total amount of fodder eaten by the animal exceeds a base value.

32. A method of automatically milking animals which are permitted to find their way individually to one or more milk boxes, at which the animals are automatically identified with the aid of a computer connected to identification means, **characterized in that** the computer is utilized for the recording of the points of time at which an animal is fed at the milk box and to activate, provided that a predetermined time has passed after the animal in question was last fed in the milk box, a device for bringing the fodder in reach of the animal, while a device for the automatic milking of animals comes into operation.

33. A construction including at least one implement for automatically milking animals, comprising a computer, at least one milk box arranged for the milking of an animal and at least one milking robot for applying teat cups to the teats of the animal and for milking the animal, which implement includes means, cooperating with the computer, for identifying an animal that has arrived at the implement, **characterized in that** the computer is utilized for the recording of the points of time at which an animal is fed at the milk box and to activate, provided that a predetermined time has passed after the animal in question was last fed in the milk box, a device for bringing the fodder in reach of the animal, while a device for the automatic milking of animals comes into operation.

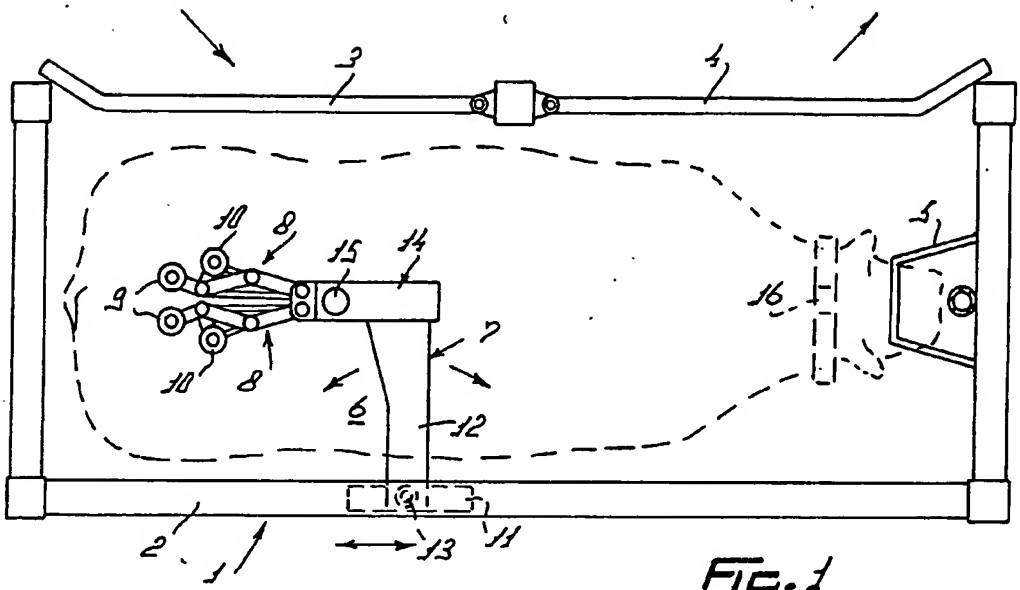
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FIG. 1

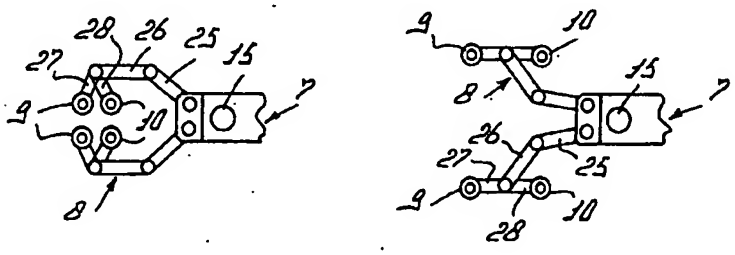
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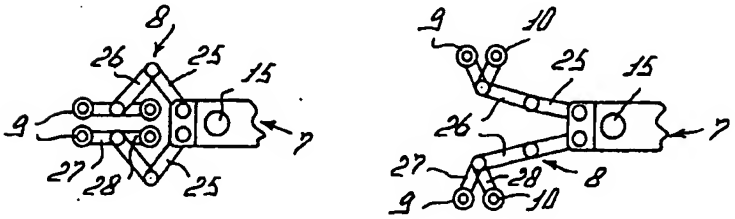
FIG. 6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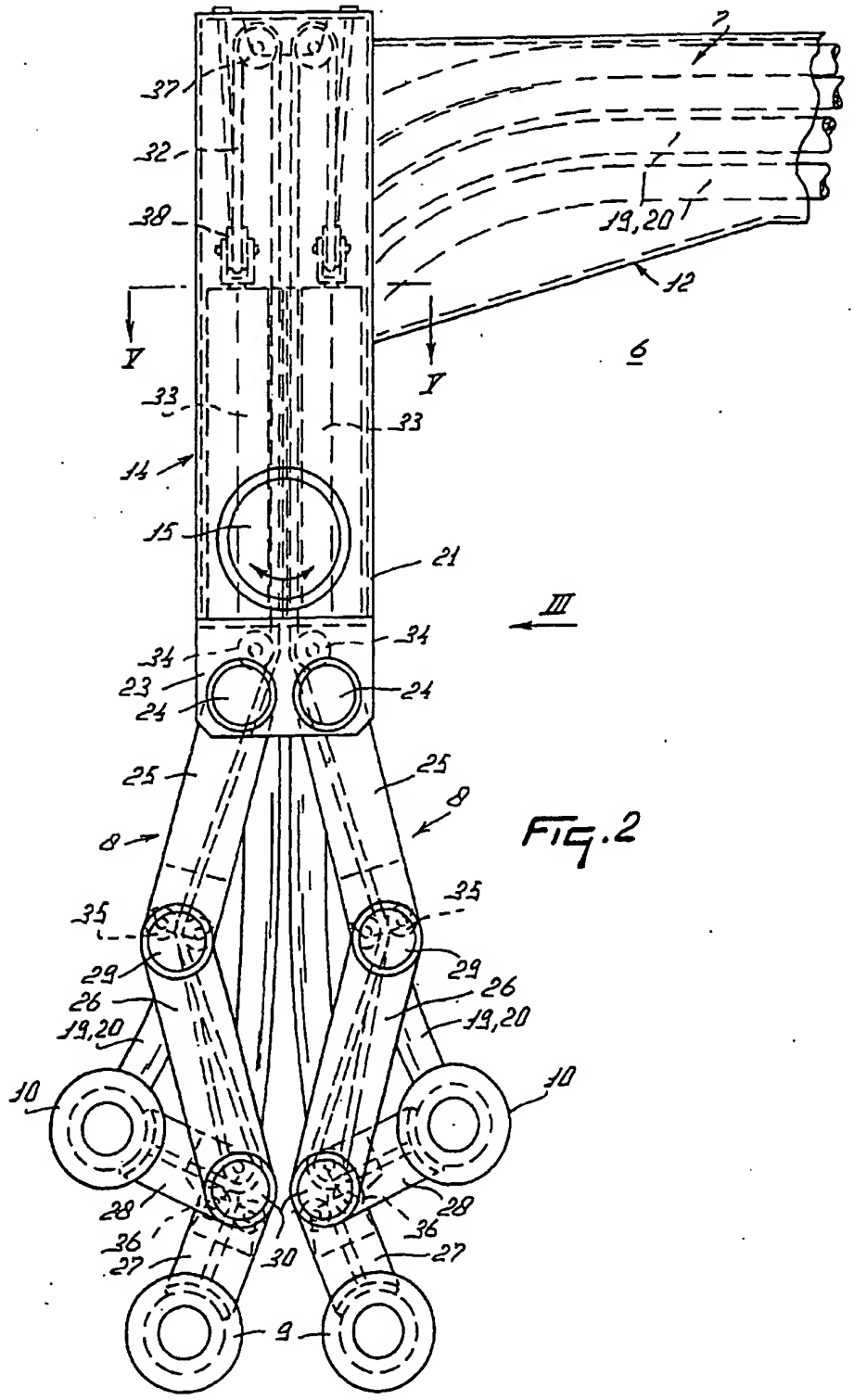
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FIG.2

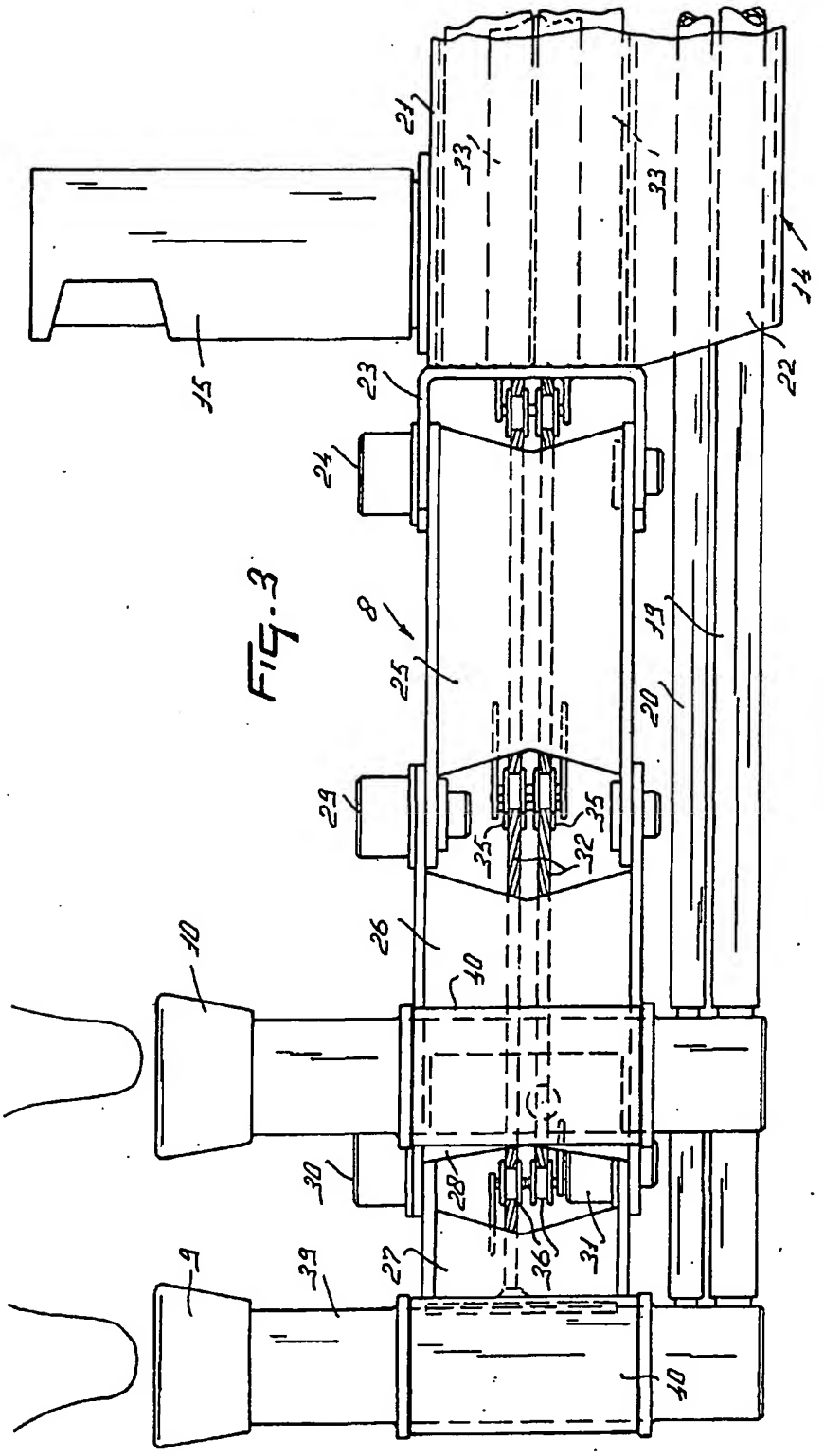

Fig. 3

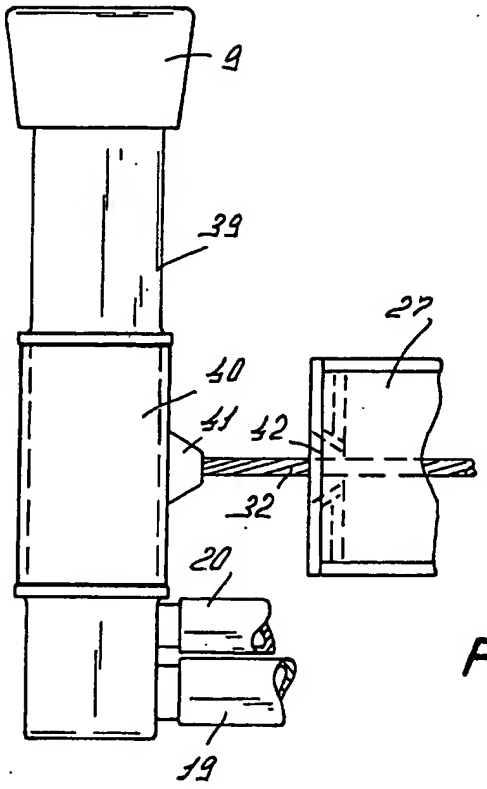

FIG. 4

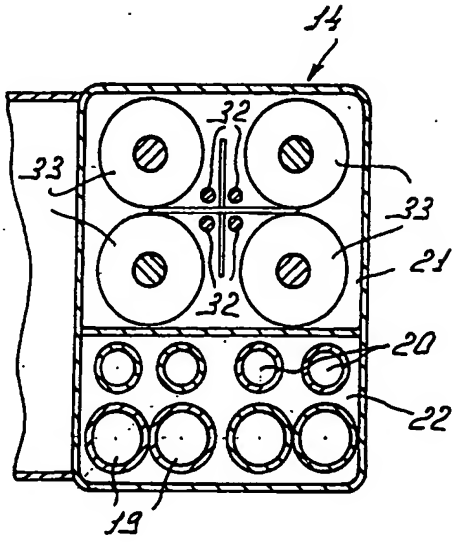

FIG. 5